TRIGGERFISHES (BALISTIDAE) OF THE WESTERN ATLANTIC[1]

DONALD MOORE
Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas

ABSTRACT

The significant external characteristics of the six species of triggerfishes (family Balistidae) which occur in the western Atlantic (*Balistes capriscus*, *B. vetula*, *Melichthys niger*, *Xanthichthys ringens*, *Canthidermis maculatus*, and *C. sufflamen*) are discussed and compared. Synonymies, illustrations, and range of each species, and a key to distinguish them are presented.

INTRODUCTION

Six species of the family Balistidae occur in the western Atlantic Ocean: *Balistes capriscus, Balistes vetula, Melichthys niger, Xanthichthys ringens, Canthidermis maculatus,* and *Canthidermis sufflamen.* This study was made to clarify their descriptions and nomenclature and to facilitate the identification of specimens. The most useful keys and comparative descriptions for the Balistidae of this region—Jordan & Evermann (1898: 1698-1712), Beebe & Tee-Van (1933: 233-237, 314), and Fraser-Brunner (1935: 658-660), the last a key to genera only—are frequently inadequate.

The six species are redescribed and illustrated to delineate (1) many of the significant external changes which take place during development from early juveniles to adults, and (2) characters, such as fin-ray counts, which remain stable throughout this period of development. Counts of the rays of three fins, proportions of ten body parts, and 13 other characters are compared for the six species. A key to facilitate the identification of juveniles and adults is included.

Most of the data were obtained from western Atlantic specimens, but some data from eastern Pacific material were used to assist in clarifying the species taxonomy and to help in analysis of a character that appeared useful for separation of the genera (distance from eye to first dorsal spine). I also used data from a study of eastern Pacific Balistidae by Berry & Baldwin (1966).

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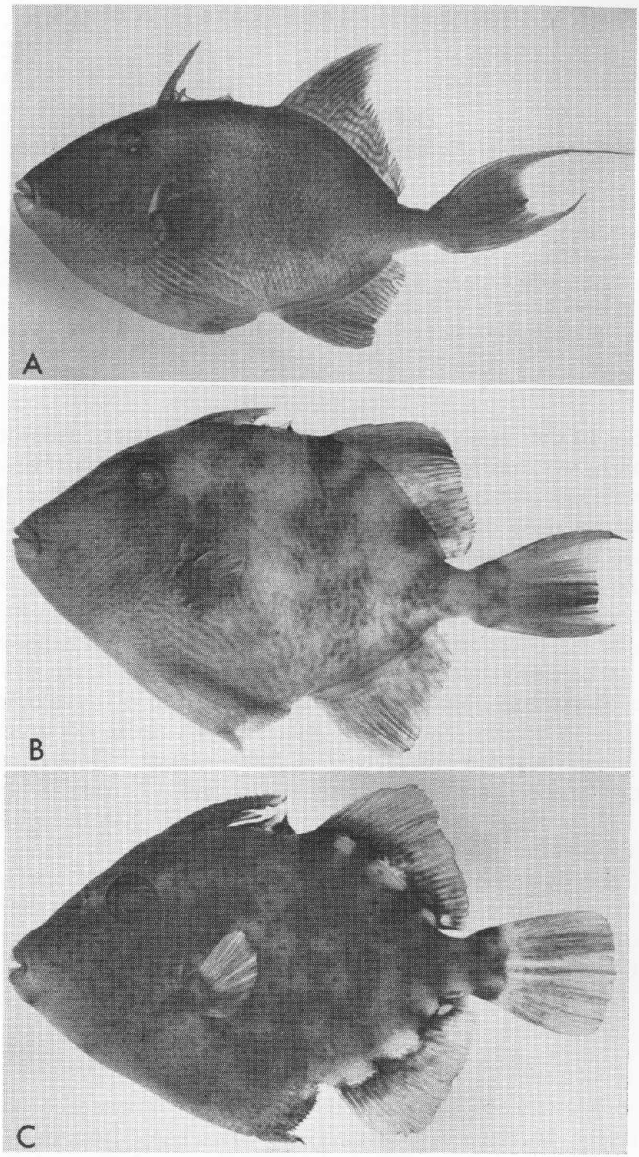

FIGURE 1. *Balistes capriscus*, gray triggerfish. A, adult, 255 mm SL (TABL, SILVER BAY 3757); B, juvenile, 116 mm SL, (TABL, SILVER BAY 2525); C, juvenile, 46.1 mm SL (TABL, SILVER BAY 4344).

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Balistes capriscus Gmelin, 1788
Gray triggerfish
Fig. 1

Balistes carolinensis Gmelin, 1788: 1468 (Carolinas, U.S.A.).
Balistes capriscus Gmelin, 1788: 1471 (American ocean; excluding references to Indian Ocean).
Balistes forcipatus Gmelin, 1788: 1472 (Brazil: after Guaperva cauda forcipata, etc., by Lister *in* Willughby, 1686: App. p. 21, and Willughby 1686: pl. I-22).
Balistes spilotopterygius Walbaum, 1792: 455 (Brazil).
Balistes buniva Lacépède, 1803: 669, pl. 21 (Nice, France).
Balistes caprinus Valenciennes, 1836-44: 94, pl. 16 (Canaries).
Balistes fulginosus DeKay, 1842: 339, fig. 188 (New York).
Balistes taeniopterus Poey, 1860: 326 (Cuba).
Balistes powellii Cope, 1870: 210 (Newport, Rhode Island).
Balistes moribundus Cope, 1871: 478 (St. Martin, West Indies).

The name *Balistes capriscus* Gmelin is used instead of *B. carolinensis* Gmelin, because *B. capriscus* was selected by the first reviser (Daudin *in* Cloquet, 1816: 476-477). *B. buniva* Lacépède is retained in the synonymy of *B. capriscus* as Briggs (1961: 554) recently suggested; some recent authors have considered it a senior synonym of *Melichthys niger* or *M. piceus* (Fowler, 1936: 1091; Gosline & Brock, 1960: 343). *Balistes forcipatus* Gmelin is a junior synonym of *B. capriscus*. Instead of describing *B. forcipatus*, Gmelin cited a description by Lister in Willughby (1686:

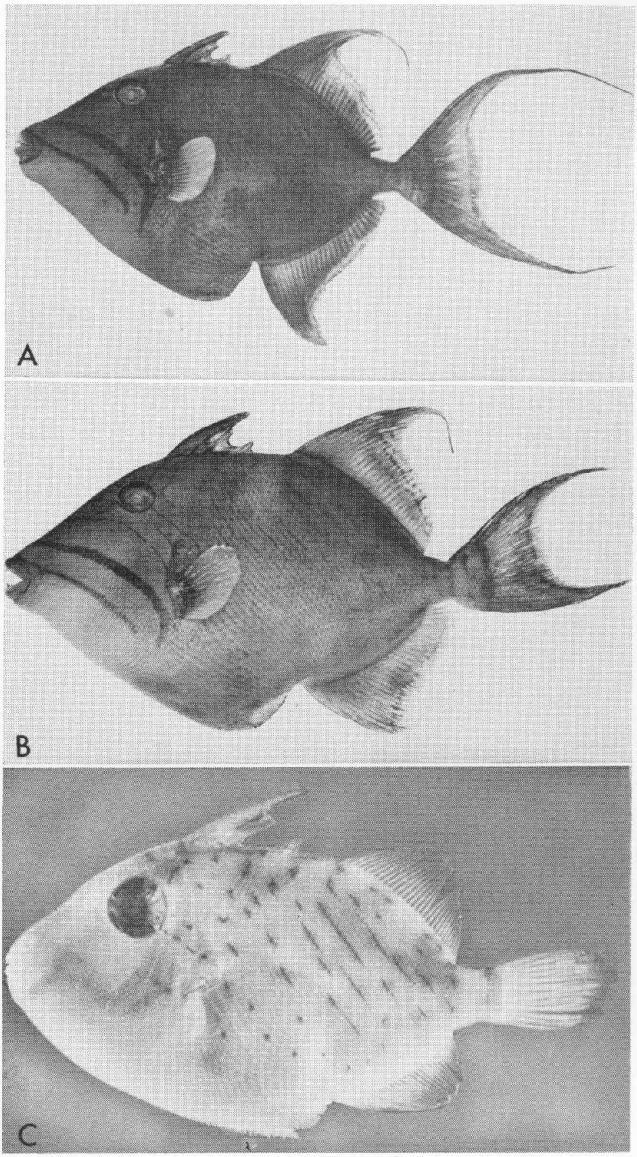

FIGURE 2. *Balistes vetula*, queen triggerfish. A, adult, 225 mm SL (TABL, OREGON 3563); B, juvenile, 176 mm SL (BLBG, SILVER BAY 3479); C, juvenile, 36.0 mm SL (ANSP 72750).

Append. p. 21) and an illustration in Willughby (1686: pl. I-22), both of which are of *B. capriscus*. *Balistes forcipatus* has been used by most authors to refer to the spotted triggerfish of the eastern Atlantic, the correct name of which is *Balistes punctatus* Gmelin, 1788 (Moore, 1967). Three other names have erroneously been placed in junior synonymy of *B. forcipatus* (of authors) relating it to the western Atlantic, but all of these are junior synonyms of *B. capriscus*. *B. spilotopterygius* Walbaum is another redescription that referred to the same description by Lister in Willughby (1686: Append. p. 21) and illustration in Willughby (1686: pl. I-22). *B. powellii* Cope, and *B. moribundus* Cope are both juveniles of *B. capriscus* which have variable color patterns.

Balistes vetula Linnaeus, 1758
Queen triggerfish
Fig. 2

Balistes vetula Linnaeus, 1758: 329 (Ascension Island: after Balistes vetula in Osbeck, 1757: 294).
Balistes bellus Walbaum, 1792: 467 (West Indies).
Balistes equestris Gray, 1854: 31-32 (America).
Balistes vetula trinitatis Nichols & Murphy, 1914: 265 (Trinidad).

The synonymies for this species have remained the same for many years.

Melichthys niger Bloch, 1786
Black triggerfish, Black durgon
Fig. 3

Balistes nigra Osbeck 1757: 295 (pre-Linnaean; Ascension Island).
Balistes niger Bloch, 1786b: 27, pl. 152, fig. 2 (plate incorrectly labeled *Balistes ringens*; China Sea).
Balistes ringens (*non* Linnaeus), Osbeck, 1765: 386 (Ascension Island).
Balistes radula Solander *in* Richardson, 1848: 21, pl. 6, figs. 1-4 (Pacific).
Balistes kibitar Thiollière, 1857: 216 (Woodlark Island).
Balistes piceus Poey, 1863: 180-181 (Cuba).
Balistes buniva (*non* Linnaeus), Günther, 1870: 227-228 (Atlantic, Indian, and Pacific oceans).
Melichthys bispinosus Gilbert, 1890: 125 (Revillagigedo Islands).
Balistes fuscolineatus Seale, 1901: 9 (Honolulu, Hawaii).

Melichthys niger Bloch is the earliest available name. Berry & Baldwin (1966) considered it to be the valid name of this species. I have concluded from examination of specimens that the western Atlantic and eastern Pacific populations of *Melichthys* are one species, and, therefore, record the Atlantic *Melichthys piceus* (Poey) and the Pacific *M. radula* (Solander) as synonyms, as many recent authors have done. *Balistes buniva* or *Melichthys buniva* (of authors) has frequently been used as the senior synonym for this species; as previously stated, however, *Balistes buniva* Lacépède is a junior synonym of *B. capriscus*.

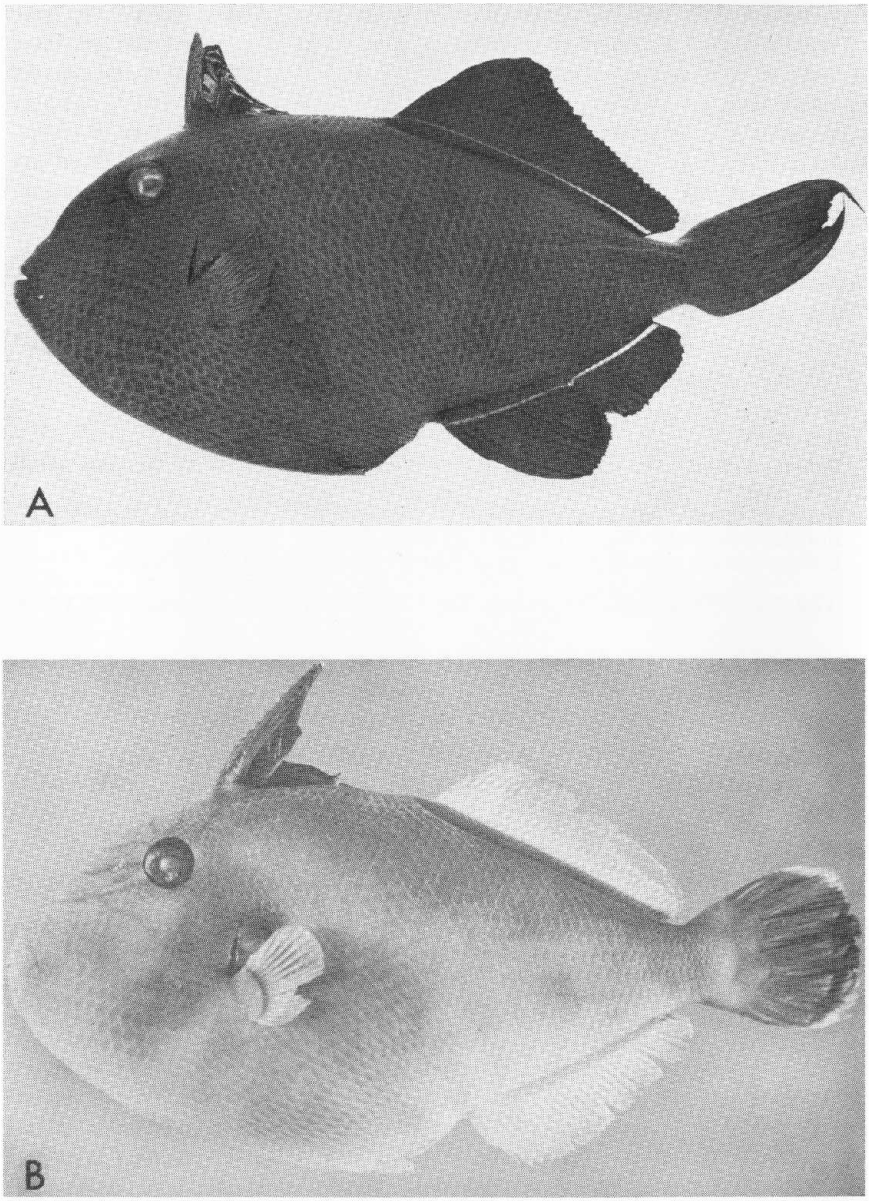

FIGURE 3. *Melichthys niger*, black triggerfish. A, adult, 179 mm SL (BU, CRAWFORD Cruise 10, 14 March, 1957); B, juvenile, 93.5 mm SL (TABL, OREGON 4987).

Xanthichthys ringens (Linnaeus, 1758)
Sargassum triggerfish, Redtail triggerfish
Fig. 4

Balistes ringens Linnaeus, 1758: 329 (locality not clearly indicated).
Balistes curassavicus Gmelin, 1788: 1472 (Curaçao).
Balistes notatus Gray, 1854: 36 (West Indies).
Balistes nitidus Gray, 1854: 36 (American oceans).
Balistes elongatus Hollard, 1854: 71 (Azores).
Balistes cicatricosus Poey, 1860: 327 (Cuba).
Balistes heckeli Müller, 1864: 182 (Mexico).

Several authors (Günther 1870: 221; Gosline & Brock 1960: 342; and Briggs 1961: 554) placed the Pacific *Xanthichthys* in the synonymy of *X. ringens* (Linnaeus). I have concluded they are distinct species since the Pacific *X. mento* has four to six, usually five, horizontal grooves between the scale rows on each cheek and 41-46 scales between the dorsal end of the gill slit and the caudal base, whereas the Atlantic *X. ringens* has three lateral cheek grooves and 38-41 scales.

Canthidermis maculatus (Bloch, 1786)
Rough triggerfish, Ocean turbot
Fig. 5

Balistes maculatus Bloch, 1786a: 202, pl. 152 (American waters).
Balistes americanus Gmelin, 1788: 1473 (America).
Balistes macropterus Walbaum, 1792: 465-466 (America).
Balistes rotundatus Procé, 1822: 130 (Manila Bay).
Balistes angulosus Quoy & Gaimard, 1824: 210 (Hawaiian Islands).
Balistes azureus Lesson, 1830: 121, pl. 10, fig. 2 (New Guinea).
Balistes oculatus Gray, 1832: pl. 90, fig. 1 (India).
Balistes willughbeii Lay & Bennett, 1839: 68, pl. 21, fig. 2 (Acapulco, Mexico).
Balistes adspersus Tschudi, 1845: 31 (Huacho, Peru).
Balistes senticosus Richardson, 1848: 23, pl. 9 (Seas of China).
Balistes brevissimus Hollard, 1854: 56, pl. 3, fig. 1 (New Guinea and Australia).
Balistes longissimus Hollard, 1854: 60, pl. 3, fig. 3 (Vanikoro, Santa Cruz Islands, Society Islands).
Balistes rufus Gray, 1854: 36 (America).
Balistes longus Gray, 1854: 36 (America).
Balistes um Thiollière, 1857: 217 (Woodlark Island).
Balistes minimum Thiollière, 1857: 217 (Woodlark Island).
Balistes melanopterus Cope, 1871: 478 (Darien, Panamá).
Canthidermis viola Herre, 1926: 534, pl. 1 (Sulu Sea).
Canthidermis longirostris Tortonese, 1954: 77-79 (Red Sea).

The type description and illustration given for *Canthidermis longirostris* Tortonese describe very well several formalin-preserved specimens of *C. maculatus* which I examined; they lacked light spots. All other junior synonyms of *C. maculatus* listed have been placed in the synonymy of this species by one or more previous authors.

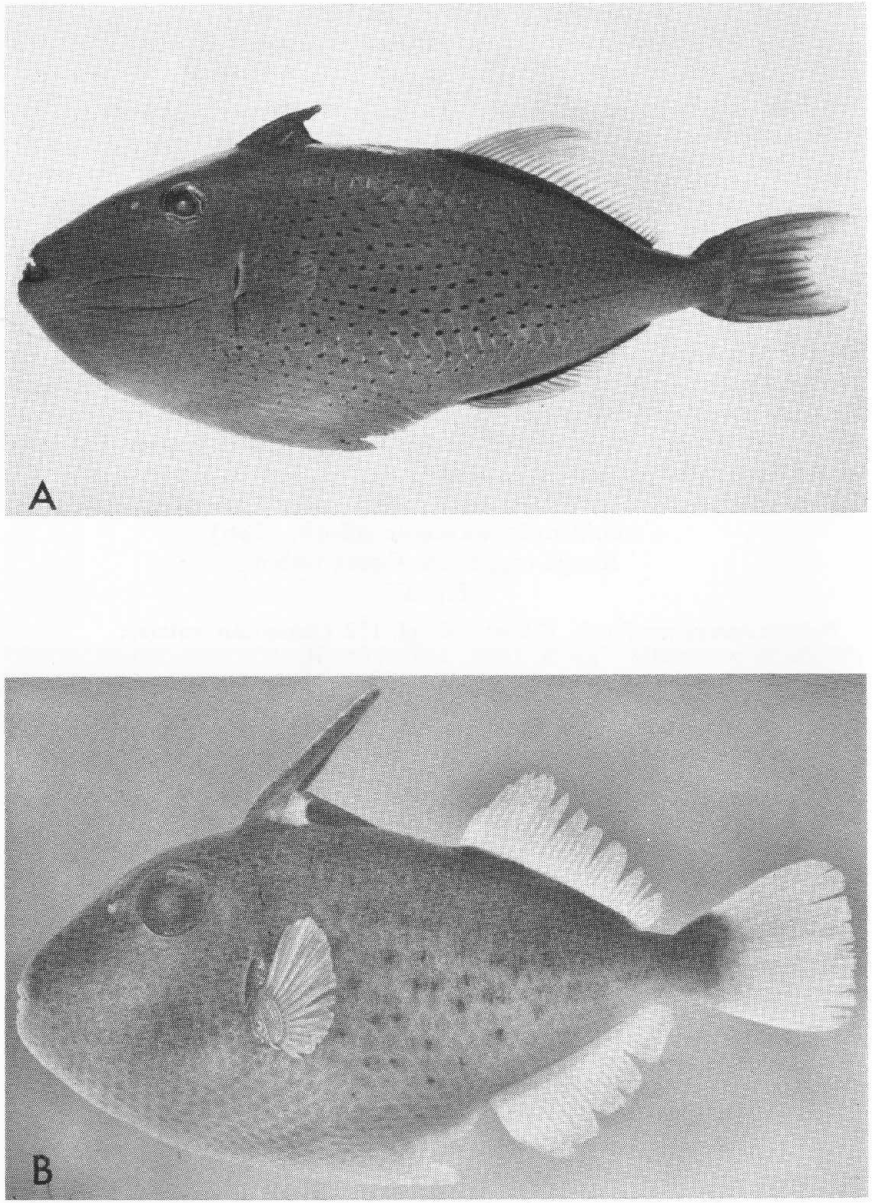

FIGURE 4. *Xanthichthys ringens*, sargassum triggerfish. A, adult, 152 mm SL (ANSP 87891); B, juvenile, 49.6 mm SL (BLBG, GILL Cr. 7, std., 26°20′N, 76°44′W).

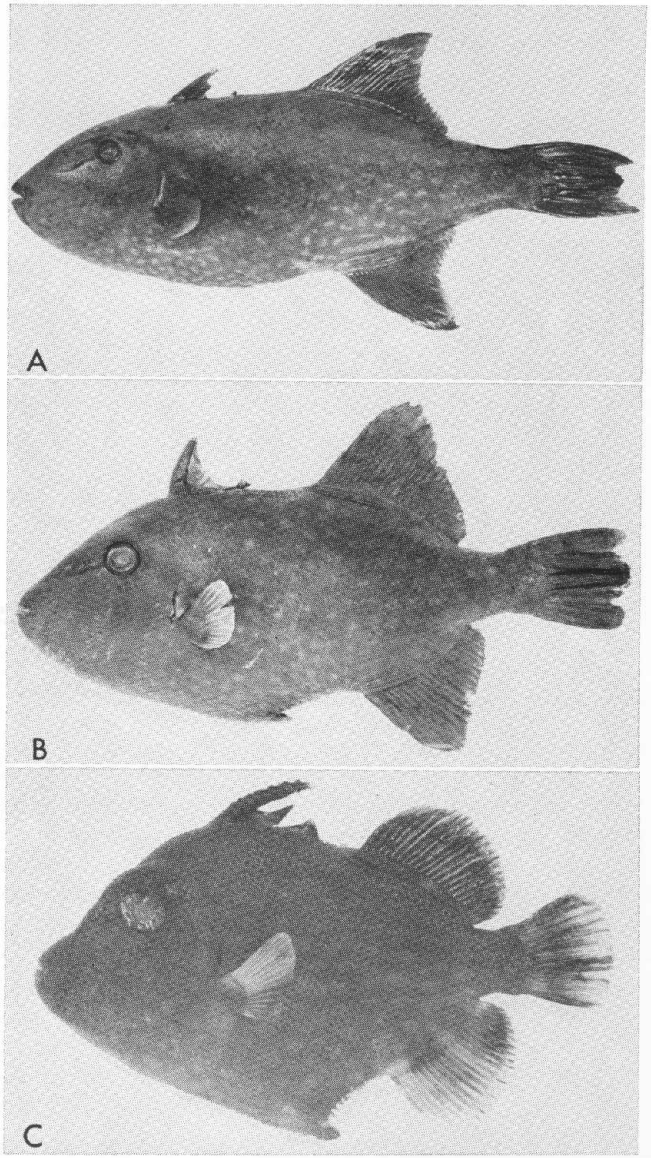

FIGURE 5. *Canthidermis maculatus*, rough triggerfish. A, adult, 315 mm SL (TABL, OREGON 2196); B, juvenile, 145 mm SL (BU, ATLANTIS, 23 November, 1957); C, juvenile, 36.8 mm SL (BU, DELAWARE, 3 September, 1957).

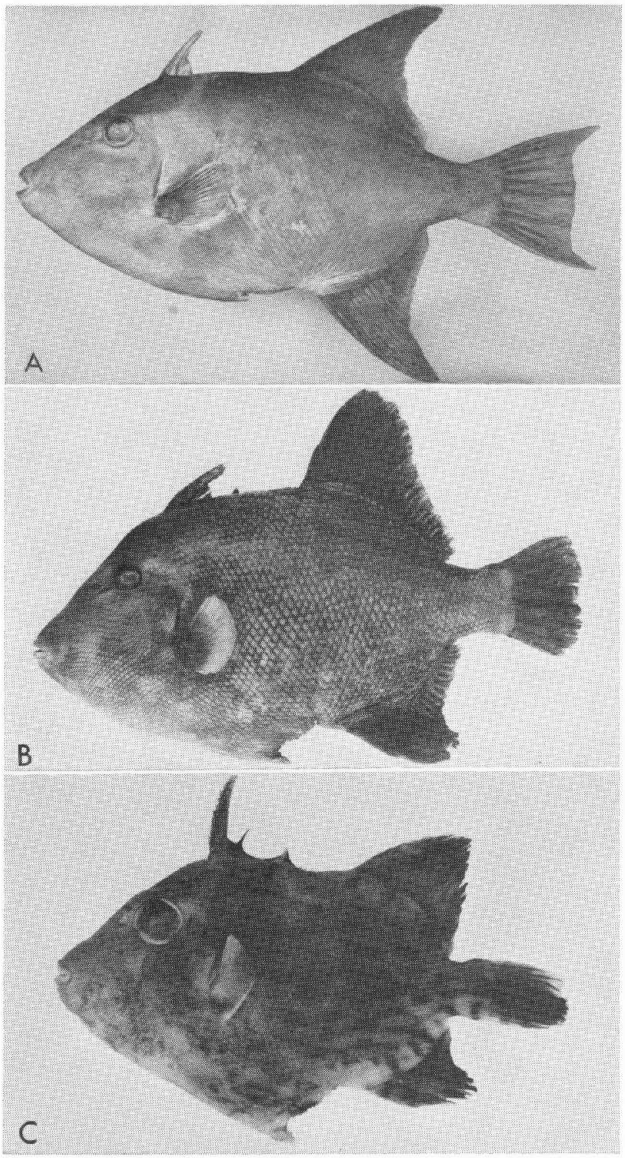

FIGURE 6. *Canthidermis sufflamen*, ocean triggerfish. A, adult, 390 mm SL (UMML, Virgin Islands, sta. 124); B, juvenile, 240 mm SL (TABL, SILVER BAY 423); C, juvenile, 38.7 mm SL (BU, DELAWARE, 3 October, 1957).

Canthidermis sufflamen (Mitchill, 1815)
Ocean triggerfish, Sobaco
Fig. 6

Balistes sufflamen Mitchill, 1815: 467 (New York).
Balistes sobaco Poey, 1860: 324-326 (Havana, Cuba).
Balistes macrops Poey, 1860: 326 (after *Sobaco* in Parra, 1787: 17, fig. 10) (Havana, Cuba).
Balistes asperrimus Cope, 1871: 478 (St. Martin, West Indies).

Canthidermis sobaco is placed in synonymy of *C. sufflamen,* as I was unable to distinguish two distinct forms in a large number of specimens examined. Jordan & Evermann (1898: 1706), in describing *Canthidermis sufflamen,* said it "Differs from *Canthidermis sobaco* in the larger eye, which is 3 in the oblique length of snout. Points of dorsal and anal longer, that of dorsal 3 in total length; produced tips of caudal longer, reaching beyond the convex middle of fin. Scales of trunk without median spine or keel. Body more elongate. Dorsal and pelvic spines smoother than in *C. sobaco*; scales generally less rough." I found that these characters, used by many subsequent investigators to distinguish the two nominal species, had wide ranges and overlapped broadly. The characters are, therefore, inadequate for the separation of these two nominal species. The description of *C. sobaco* generally describes juvenile or early adult specimens of *C. sufflamen.*

Key to Western Atlantic Species of Balistidae[2]

1A. Two or more enlarged scales or plates immediately posterior to the gill opening, the plates distinctly larger than any other lateral scales on the trunk. Pelvic process with a flexible joint connecting the external exposed part to the remainder of the process lying underneath the skin 2

1B. No enlarged scales or plates immediately behind gill opening, any modified scales present not as large as the other scales on side of body. Pelvic process not flexible, the exposed and internal parts continuous 4

2A. About 8 to 11 horizontal rows of ridged scales bearing anteriorly directed spines along sides of peduncle and area between anal and soft dorsal fins. Anal rays 29-31. Dorsal rays 31-35. Pectoral rays 15-17 ..... *Melichthys niger*

2B. No horizontal rows of ridged scales bearing anteriorly directed spines on sides of body and peduncle. Anal rays 23-28 3

3A. Head with two broad, curved, dark or blue bands on cheek, and

[2] Many characters in the key, other than articulation of pelvic process and numbers of fin rays, may not apply to specimens shorter than 50 mm SL. Data from specimens shorter than 10 mm SL were not included in this study.

several narrow dark or blue bands radiating from eye. Anal rays 27-28. Dorsal rays 29-31. Pectoral rays 14-15. Longest dorsal soft ray 36-71 per cent SL on specimens larger than 150 mm SL ..... *Balistes vetula*

3B. Head without prominent dark or blue bands. Anal rays 23-26. Dorsal rays 26-29. Pectoral rays 14-15 (13). Longest dorsal soft rays 23-29 per cent SL on specimens larger than 150 mm SL ..... *Balistes capriscus*

4A. Scales on cheek fused together in horizontal rows, between which are narrow and parallel naked areas or grooves. Least distance from eye to first dorsal spine 8-10 per cent SL. Peduncle depth 7-8 per cent SL. Anal rays 23-27. Dorsal rays 26-30. Pectoral rays 13-14 ..... *Xanthichthys ringens*

4B. Cheek completely scaled, without horizontal grooves. Least distance from eye to first dorsal spine 12-18 per cent SL. Peduncle depth 10-15 per cent SL 5

5A. Anal rays 20-22. Dorsal rays 23-25. Pectoral rays 13-15. Body depth 36-45 per cent SL on specimens larger than 150 mm SL ..... *Canthidermis maculatus*

5B. Anal rays 23-25. Dorsal rays 25-28. Pectoral rays 15-16. Body depth 47-63 per cent SL on specimens larger than 150 mm SL ..... *Canthidermis sufflamen*

Analysis of Characters

Pigmentation and Coloration.—The following descriptions of pigmentation and color are of preserved specimens unless stated otherwise.

Balistes capriscus has a generally gray body with four dark patches at the second dorsal-fin base. One patch, a very dark saddle beneath the origin of the second dorsal fin, is distinct on most specimens and remains distinct on specimens preserved for many years; a second, less dark patch lies beneath rays 7-10 of the second dorsal fin; a third, even less dark patch lies beneath rays 18-22 of the second dorsal fin; and a fourth, narrower patch forms a saddle that lies just posterior to the second dorsal fin. Vertically elongated patches of pigment tend to form four irregular vertical bars on each side; one is located above and below the orbit, another below a point between the second and third dorsal spines, a third below the base of the first six dorsal soft rays, and a fourth below the posterior end of the second dorsal base (Fig. 1). The posterior two bars blend with the saddles. These bars are sometimes very faint (Fig. 1A), and usually are more distinct on juveniles (Fig. 1B). Dark lateral reticulations and light spots often occur on the second dorsal and anal fins. The reticulations tend to form dark stripes in the middle and posterior part of the fin. Juveniles less than 50 mm SL have many small, dark, rounded spots and larger, irregular dark

patches on the body, and mostly translucent second dorsal-, anal-, and caudal-fin membranes (Fig. 1C). Saddles similar to those on the dorsal fin are also present on the anal fin of early juveniles. The saddles are interspersed with light spots. On live specimens, I have observed quick changes in the intensity of dark pigment in the four vertical bands and the dark reticulations (blue on live specimens) of the dorsal and anal fins.

Balistes vetula has a gray body with two broad, dark bands, and one dark line above them, proceeding posteroventrally from the snout to the vicinity of the pectoral-fin base (Fig. 2A & B). There is another dark band immediately under the lower lip. About eight wavy, dark lines radiate from the eye. The dorsal surface of the eye has about six dark spots. Several wavy, dark reticulations cross the dorsal and anal fins. The distal margins of these fins are light. Vertical dark bands cross the caudal base, and a dark band crosses the caudal rays near the distal margin of the caudal fin. On juveniles below 50 mm SL, dark, broken lines run along some of the anterodorsal to posteroventral diagonal rows of scales on the sides (Fig. 2C); this character is present, but indistinct, on some of the larger specimens (Fig. 2B). The small juveniles also have generally translucent dorsal-, anal-, and caudal-fin membranes. Often the two broad bands which are present above the jaw on larger specimens are indistinct in small juveniles (Fig. 2C). On live and fresh specimens the dark bands and reticulations are blue. Townsend (1929:344, pl. 25), in illustrating color phases of *B. vetula*, noted a dull color pattern, in which the dark diagonal bars along the scale rows were most prominent. He found this pattern on fish during rest as well as during fright.

Melichthys niger has the darkest pigmentation of any adult western Atlantic balistid (Fig. 3A). Recently preserved, small juvenile specimens of *C. maculatus* are also very dark (Fig. 5C). The entire body, including the fins, is black, except for a narrow white band along the second dorsal and anal fins near their bases. The band is slightly broader posteriorly. On many specimens, dark lines which radiate above and before the eye are similar to the lines radiating from the eye on *B. vetula.* The smallest specimen examined, a prejuvenile of 93.5 mm (SL) had a paler body than did the adults; the entire second dorsal and anal fins were translucent instead of dark, and the dorsal and ventral distal margins of the caudal fin were white (Fig. 3B). In aquaria, the adults had a black body with a slight chestnut color on the upper cheek, and blue instead of white stripes near the bases of the second dorsal and anal fins. Randall (1955: 220-221) noted that, when they are living in their natural habitat, specimens of the Pacific *M. niger* have narrow, bright blue lines at the bases of the soft dorsal and anal fins.

Xanthichthys ringens has a generally bronze-yellow hue which, in adults, is lighter on the belly than on the back (Fig. 4A). Most of the side pos-

terior to the head, including the area under the pectoral fin, has distinct dark spots at each junction of four scales. Two of the three horizontal grooves between the scale rows on the cheek contain very dark pigment. The head, belly, and the regions near the dorsal, anal, and caudal bases lack spots. The first dorsal-fin membrane in both adults and small juveniles is very dark except near the bases of the first two spines (Fig. 4B). The second dorsal- and anal-fin membranes are translucent, but their bases are very dark. In small juveniles, the dorsal half of the body is darker than the ventral half, and the large, irregular dark spots on the sides are larger and fewer than on adults (Fig. 4B). Small juveniles lack horizontal cheek grooves. A few spots occur on the side of the head of specimens under 30 mm SL. Fresh specimens of small juveniles are dark gray on the upper half of the side of the body.

Canthidermis maculatus has a gray-to-brown body that is lighter or more buff ventrally (Fig. 5A & B). Usually, many light spots occur on the sides and ventral surface of the body (9-17 spots between the origins of the second dorsal and anal fins) and on the dorsal and anal fins. Spots are numerous, though often less distinct, on the cheeks and throat. Dorsal- and anal-fin membranes are dark and frequently are spotted. Some specimens, including some recently preserved ones, lack spots. On specimens of 10-50 mm SL, the color patterns are darker and the light spots are more irregular (Fig. 5C). Specimens measuring 10-20 mm SL have about three black papillae or small fleshy protrusions just above the lateral line near the peduncle. In all sizes, the first dorsal-fin membrane is dark and the pectoral fin is unmarked. On live specimens (none was examined) the presence of light spots, as in *C. sufflamen*, probably is variable.

Canthidermis sufflamen also has a gray-to-brown body that is lighter or more buff ventrally (Fig. 6A). The dorsal-, anal-, and caudal-fin membranes are dark, and the pectoral fin is mostly unmarked at all sizes (Figs. 6A & B). Specimens measuring less than 100 mm SL have irregular buff to dark-gray or brown spots on the body and over much of the second dorsal, anal, and caudal fins (Fig. 6C). The membrane of the first dorsal fin is dark on the small juveniles. Many small juveniles have three to six small, black papillae or small fleshy protrusions just above the lateral line at the peduncle and below the first dorsal fin. Very small specimens, 10-20 mm in SL, often have dark, laterally elongated oval spots on a light gray background. In an aquarium, a specimen which measured 175 mm SL intermittently exhibited white spots on the posterior half of the body including the second dorsal, anal, and caudal fins. These spots were larger and less numerous than those usually found on preserved specimens of *C. maculatus*. On a specimen captured by dipnet, similar white spots disappeared after the fish was preserved.

Pelvic Process.—In all species of *Balistes* and *Melichthys* examined, the pelvic process (the rays and encasing scales protruding postero-ventrally on the terminal end of the basypterigium) is flexible in a dorso-ventral plane at approximately the point of emergence from the body. The flexibility between the two proximal, encasing, scale segments that allows movement of the distal segments in the dorso-ventral plane was described in detail by Tyler (1962: 227-229). No lateral movement of the pelvic process is possible in any of the species studied. *Canthidermis* and *Xanthichthys* have no flexible articulation between segments of the pelvic process.

Dorsal, Anal, and Pectoral Rays.—As in all species of Balistidae, the first dorsal fins of the six species have three spines. The pectoral fins have a short spine on the dorsal edge of the fin origin, which is prominent in very small juveniles but reduced to a slight knob in adults. Table 1 gives the frequency distribution in each of the six species for the numbers of soft rays in the second dorsal, anal, and pectoral fins. Most specimens were bilaterally symmetrical in numbers of pectoral-fin rays (*B. capriscus*, 95 per cent; *B. vetula*, 87 per cent; *M. niger*, 90 per cent; *X. ringens*, 83 per cent; *C. maculatus*, 83 per cent; and *C. sufflamen*, 84 per cent). The first three species in Table 1 (those with a flexible pelvic process) may be separated from each other by the number of anal rays. The last three species (those having an inflexible pelvic process) may be separated as follows: *C. maculatus* from *C. sufflamen* and *X. ringens* by number of anal rays; and *C. sufflamen* from *X. ringens* by number of pectoral rays.

Profile of Second Dorsal Fin.—On large juveniles and adults of all six species, the anterior part of the second dorsal fin is elevated; the second to seventh rays are the longest. On small juveniles, the longest rays may be as far back as the ninth or tenth. The anterior part of the second dorsal fin is produced in large adult specimens of *B. capriscus, B. vetula, C. maculatus*, and *C. sufflamen.* Adults of *B. vetula* also have several long, filamentous rays in the produced part of the fin (Fig. 2A).

Profile of Anal Fin.—The second to sixth anal-fin rays are the longest on large juveniles and adults of all six species. In adults, the anterior part of the fin is distinctly produced in *B. vetula* (Fig. 2A & B), *C. maculatus* (Fig. 5A & B), and *C. sufflamen* (Fig. 6A & B); it is elevated in *B. capriscus* (Fig. 1A & B) and *M. niger* (Fig. 3) but only slightly elevated in *X. ringens* (Fig. 4A).

Modified Scales on Cheek.—The scales of *X. ringens* in the region between the lower jaw and the gill opening (Fig. 4A) are vertically elongated rectangles or parallelograms. On specimens which measure over 500 mm SL, four rows of these scales are separated by three lateral grooves (Fig. 4A). The two upper grooves are wider and more pronounced than the lower one, which may be indistinct. On specimens which are about 40-50 mm SL,

TABLE 1

FREQUENCY DISTRIBUTIONS OF SOFT RAYS IN SECOND DORSAL, ANAL, AND PECTORAL FINS OF THE SIX SPECIES OF WESTERN ATLANTIC BALISTIDAE

	Dorsal soft rays													Anal soft rays												Pectoral soft rays[1]				
	23	24	25	26	27	28	29	30	31	32	33	34	35	20	21	22	23	24	25	26	27	28	29	30	31	13	14	15	16	17
B. capriscus	—	—	—	2	39	47	6	—	—	—	—	—	—	—	—	—	1	40	46	7	—	—	—	—	—	3	165	7	—	—
B. vetula	—	—	—	—	—	—	5	21	4	—	—	—	—	—	—	—	—	—	—	—	—	19	11	—	—	—	54	6	—	—
M. niger	—	—	—	—	—	—	—	1	2	6	9	4		—	—	—	—	—	—	—	—	—	5	8	9	—	—	3	33	6
X. ringens	—	—	—	1	5	8	14	1	—	—	—	—	—	—	—	—	1	3	11	11	3	—	—	—	—	41	13	—	—	—
C. maculatus	8	18	9	—	—	—	—	—	—	—	—	—	—	5	17	13	—	—	—	—	—	—	—	—	—	4	37	26	—	—
C. sufflamen	—	—	4	26	29	3	—	—	—	—	—	—	—	—	—	—	17	38	7	—	—	—	—	—	—	—	—	72	54	—

[1] Includes individual counts on each of both fins of most specimens.

these scale rows are only slightly separated from each other (Fig. 4B). The scale pattern is similar in specimens smaller than 40 mm SL, but without spaces or grooves between scale rows. The other five species lack distinctly modified cheek scales.

Scale Rows on Body.—The irregularity of scale rows on the body makes precise counts of lateral or dorsoventral scales difficult on many juveniles. Counts of the number of anterodorsal to posteroventral scale rows between the dorsal end of the gill opening and the caudal base range as follows: *X. ringens*, 38-41; *C. maculatus*, 42-49; *B. vetula*, 45-51; *B. capriscus*, 48-53; *C. sufflamen*, 49-53; and *M. niger*, 50-57.

Ridges and Spines on Scales.—*M. niger* has eight to eleven horizontal rows of ridged scales, on the sides at the peduncle and between the second dorsal and anal fins, that bear anteriorly directed spines (Fig. 3). No such scale rows were found in the other five species. Each scale on the sides of small juvenile specimens of *B. capriscus*, *B. vetula*, *C. maculatus*, and *C. sufflamen* has a single spine. In *B. capriscus* and *B. vetula*, these scale-spines become rudimentary or disappear in specimens measuring 25 to 40 mm SL, and are absent in larger specimens; in *C. maculatus* they are rudimentary by the time individuals reach 200 to 430 mm SL and disappear by the time that 475 mm SL is reached; and in *C. sufflamen* they are usually lacking on specimens over 400 mm SL. The only specimen of *X. ringens* that had scales with spines was an 18.1-mm specimen, the smallest examined; however, the spines were rudimentary.

Lateral Line.—The location of the lateral line is similar in all six species. Lateral-line branches are above and below the orbit. The branches unite just posterior to the orbit to form a single line that proceeds posteriorly, and slightly dorsally, to its dorsalmost position just below the base of the third dorsal spine. From that point, the lateral line proceeds abruptly downward to its ventralmost position, following an anterodorsal to posteroventral, vertical row of scales for about three-fourths of the distance to the anal-fin base; then the line turns abruptly upward and follows an anteroventral to posterodorsal row of scales to the middle of the side, and thence runs posteriorly along the middle of the side to the caudal base. On *M. niger*, the lateral line is often indistinct at or near its ventralmost position. I did not find the lateral line in *B. vetula* to be incomplete, as stated by Jordan & Evermann (1898: 1703).

Modified Scales above Pectoral Fins.—*M. niger* and the two species of *Balistes* have several prominent enlarged scales or plates just above the dorsal end of the pectoral insertion and posterior to the gill opening (best illustrated in Fig. 2B). Two modified scales, of somewhat irregular shape and larger than the other modified scales, are located side by side; there are several smaller modified scales or plates above them. I have found

that adult and large juvenile specimens of *X. ringens* have about eight small, modified scales or plates, none as large as the largest normal scales on the trunk. On juveniles smaller than 50 mm SL, these modified scales are as large as, or larger than, normal scales. *X. ringens* has been described previously as having no "osseus plates" above the pectoral fins (Jordan & Evermann, 1898: 1699, 1708-9; Fraser-Brunner, 1935: 658-60). The two species of *Canthidermis* lack modified scales above the pectorals, at any size.

Teeth.—All six species have eight premaxillary and eight dentary teeth. On specimens of *M. niger* of 126 mm SL and larger, these teeth are white, and all are incisors. The premaxillary bone of a 96-mm *M. niger* has one incisor and seven cuspids. All 16 teeth are cuspids on the smallest specimen (93.5-mm SL) examined. The maxillary and anterior dentary teeth of the other five species are cuspids, in all specimens regardless of size.

Vertebrae.—Vertebrae are 7 + 11 in all of the specimens examined in each species (seven specimens of *B. capriscus*, three of *B. vetula*, two of *M. niger*, six of *X. ringens*, eleven of *C. maculatus*, and seven of *C. sufflamen*).

Sexual Dimorphism.—The lower jaw projects antero-ventrally in adult males of *M. niger*, but not in females (Fig. 3A). No sexual dimorphism was observed in the other species.

Body Proportions.—The data for proportional measurements on which the discussion below is based are to be found in Table 2.

SNOUT LENGTH: Snout length is here defined as the least distance from the tip of the snout to the orbit. On specimens longer than 100 mm SL, snout length may be used to separate most specimens of *Balistes* (23-28 per cent SL) from those of *M. niger*, *X. ringens*, and *C. maculatus* (18-23 per cent SL). Snout lengths of *C. sufflamen* (21-23 per cent SL) are less than those in *B. vetula* (26-28 per cent SL) and overlap those of the other four species. On specimens between 10-50 mm SL, the snouts of *B. capriscus*, *B. vetula*, *X. ringens*, *C. maculatus*, and *C. sufflamen* are generally short, usually proportionately the same as those on the larger specimens of *Melichthys*, *Xanthichthys*, and *Canthidermis*.

EYE DIAMETER: The eye diameter is defined as the horizontal diameter inside the orbit. Eye diameter serves to separate some species which occur in the western Atlantic. *Balistes* generally has larger eyes than *Melichthys*, in specimens larger than 100 mm SL. (In the 100- to 200-mm range in SL: *Balistes* = 8-10 per cent SL; *Melichthys* = 7 per cent SL. In the 200- to 300-mm range in SL: *Balistes* = 6-9 per cent SL; *Melichthys* = 5-6 per cent SL.) In specimens larger than 200 mm SL, the eye diameter changes little with further increase in body length.

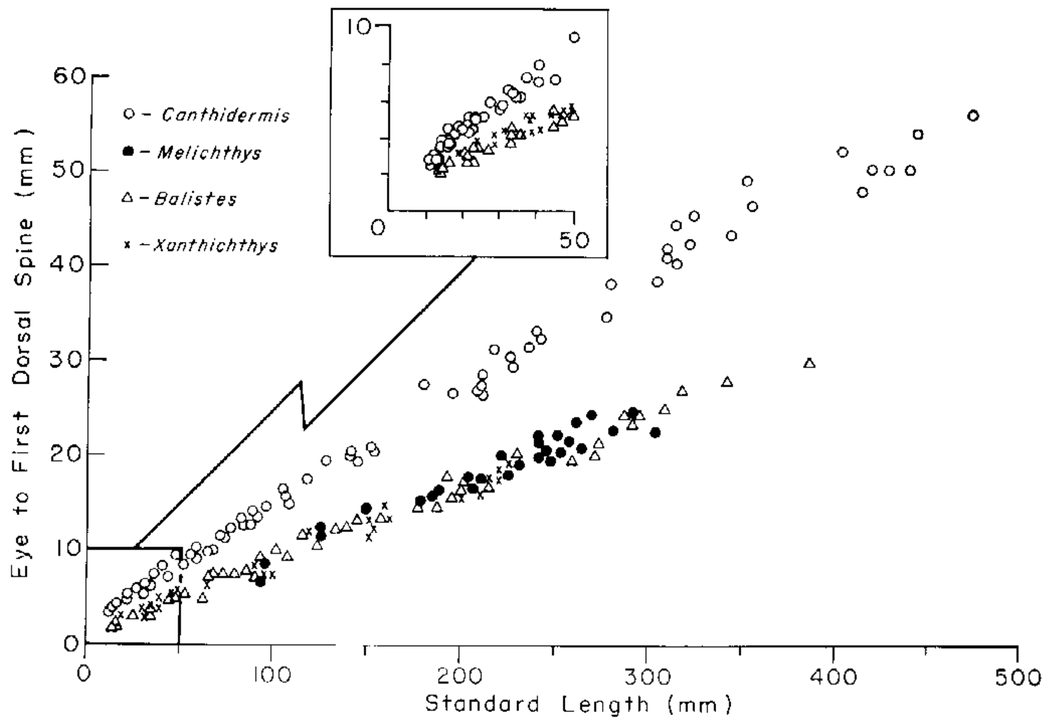

FIGURE 7. Relation between standard length and the distance from eye to first dorsal spine, for *Canthidermis*, *Melichthys*, *Balistes*, and *Xanthichthys*, including the Pacific specimens examined.

INTERORBITAL WIDTH: The interorbital width is the least width across the frontal between the orbits. The interorbital width in *Canthidermis* is greater than in *Balistes* and *Melichthys*, for specimens ranging from 50 to 100 mm SL (*Canthidermis*, 14-17 per cent SL; *Balistes* and *Melichthys*, 10-13 per cent SL); and is greater than in all other species, for specimens in the 100- to 200-mm range in SL (*Canthidermis*, 13-16 per cent SL; the other four species, 8-12 per cent SL). In specimens which are over 200 mm SL, *Canthidermis* (11-13 per cent SL) may still be separated from *Balistes* (8-10 per cent SL). Data obtained from examination of the larger Pacific species of *Melichthys* and *Xanthichthys* indicate that the values for interorbital width in specimens larger than 250 mm SL range between those for *Canthidermis* and *Balistes*. For all sizes, interorbital width in *Canthidermis* is generally greater than in *Balistes*. In *X. ringens*, which has a smaller interorbital width as a large juvenile or adult, the width is as great as in *Canthidermis* for specimens whose size is between 20 and 50 mm SL.

DISTANCE FROM EYE TO FIRST DORSAL SPINE: This distance is taken as the least distance from the orbit to the anteriormost insertion of the first dorsal spine. The distance from the eye to the first dorsal spine is greater

TABLE 2

PROPORTIONAL MEASUREMENTS FOR TEN BODY AND FIN PARTS OF WESTERN ATLANTIC SPECIES OF BALISTIDAE, IN PERCENTAGE OF STANDARD LENGTH, BY SELECTED RANGES OF STANDARD LENGTH

	Size range (mm SL)						
	10–20.0	20.1–50	50.1–100	100.1–150	150.1–200	200.1–300	300.1 and over
				Snout length			
B. capriscus	19–21 (4)[1]	18–23 (11)	21–25 (14)	23–25 (9)	23–26 (4)	24–26 (7)	25–26 (2)
B. vetula	20 (1)	21–24 (8)	23–26 (2)	27 (2)	26–28 (6)	26–28 (7)	26 (1)
M. niger	–	–	22–23 (2)	23 (2)	19–20 (3)	21–22 (14)	–
X. ringens	25 (1)	20–25 (16)	20–21 (4)	20–23 (2)	20–21 (5)	–	–
C. maculatus	17–21 (5)	19–22 (5)	20–21 (6)	19–21 (8)	19–20 (2)	19 (3)	18–19 (3)
C. sufflamen	18–23 (16)	18–22 (15)	20–24 (14)	22 (1)	23 (2)	22 (3)	21–23 (10)
				Eye diameter			
B. capriscus	15–18	11–16	10–12	8–10	8–9	6–8	6
B. vetula	15	13–14	10–11	9	8–10	7–9	7
M. niger	–	–	7–8	7	7	5–6	–
X. ringens	16	11–15	9–11	8–10	7–8	–	–
C. maculatus	16–19	11–18	10–11	8–10	8	6	5–6
C. sufflamen	16–19	12–15	9–13	–	7	6–7	6–7
				Interobital width			
B. capriscus	17–19	10–17	11–13	10–11	10	9–10	8–9
B. vetula	20	11–13	10	8–9	8–9	8–10	9
M. niger	–	–	12–13	11	10	10–11	–
X. ringens	20	14–21	11–16	11	9–12	–	–
C. maculatus	24–27	18–22	14–16	13–16	13	12–13	11–12
C. sufflamen	17–22	14–20	14–17	14	14	13	11–13

[1] Number of specimens examined in parentheses.

TABLE 2 (CONTINUED)

	Size range (mm SL)						
	10–20.0	20.1–50	50.1–100	100.1–150	150.1–200	200.1–300	300.1 and over
				Distance from eye to first dorsal spine			
B. capriscus	15–18	11–16	9–11	9–10	8–9	8–9	8
B. vetula	16	10–12	8–10	9	8	7–9	8
M. niger	–	–	9	10	8–9	8–9	–
X. ringens	18	11–16	8–10	8–10	8–9	–	–
C. maculatus	24–28	17–24	15–17	13–16	14	13–14	13–14
C. sufflamen	22–25	16–22	14–18	14	15	13–14	12–14
				Distance from snout to first dorsal spine			
B. capriscus	44–47	38–43	38–41	38–40	36–39	36–39	35–38
B. vetula	45	40–44	41	42	40–42	38–42	37
M. niger	–	–	34–35	34	29–30	30–33	–
X. ringens	50	39–49	34–36	33–35	31–32	–	–
C. maculatus	53–56	41–53	37–44	36–40	36	34–36	32–35
C. sufflamen	51–61	44–51	42–46	42	41	37–39	34–39
				Length of third dorsal spine			
B. capriscus	10–12	7–10	5–8	5–7	5	2–6	5
B. vetula	13	6–11	6–8	4–6	4–7	5	4
M. niger	–	–	1–2	1	0–1	0–2	–
X. ringens	2	0–2	0	0	0–2	–	–
C. maculatus	4–8	2–6	3–6	3–5	2	2	1–2
C. sufflamen	5–8	5–8	4–7	6	5	1–2	0–2

TABLE 2 (CONTINUED)

	Size range (mm SL)						
	10–20.0	20.1–50	50.1–100	100.1–150	150.1–200	200.1–300	300.1 and over
				Length of longest dorsal soft ray			
B. capriscus	16–19	16–22	18–29	20–28	23–28	25–29	26
B. vetula	18	15–23	22–25	29–30	36–50	42–71	50
M. niger	–	–	13	20	20–21	17–22	–
X. ringens	16	14–16	14–20	19–21	18–22	–	–
C. maculatus	17–19	17–21	20–28	22–27	24–26	24–26	22–25
C. sufflamen	16–26	17–26	20–28	–	24	24–36	30–36
				Length of longest anal soft ray			
B. capriscus	17–20	16–18	15–26	20–23	20–23	22–24	21–22
B. vetula	16	14–18	20	22–23	25–27	25–28	24
M. niger	–	–	12	18–20	19–20	16–19	–
X. ringens	17	13–16	14–17	18–19	16–19	–	–
C. maculatus	17–20	17–21	20–25	21–26	24–25	23–24	21–22
C. sufflamen	15–20	16–24	14–26	–	26	25–33	28–35
				Body depth			
B. capriscus	63–70	54–64	52–67	50–63	51–57	48–55	49–51
B. vetula	61	56–64	62	57–59	53–60	52–59	52
M. niger	–	–	50–53	45–58	49–52	48–58	–
X. ringens	64	48–60	49–51	45	42–53	–	–
C. maculatus	64–76	58–70	50–62	46–54	42–45	41–42	36–38
C. sufflamen	63–77	56–70	56–66	54	56–63	55–58	47–54
				Depth at caudal peduncle			
B. capriscus	11–13	11–13	9–12	9–10	9	8–9	8
B. vetula	10	9–10	9	9	8–9	7–9	8
M. niger	–	–	10	10	8–9	9–10	–
X. ringens	9	8–10	8	8	7–8	–	–
C. maculatus	13–19	12–15	11–14	12–14	12	12	10–12
C. sufflamen	12–15	11–14	11–15	13	13	13–14	11–13

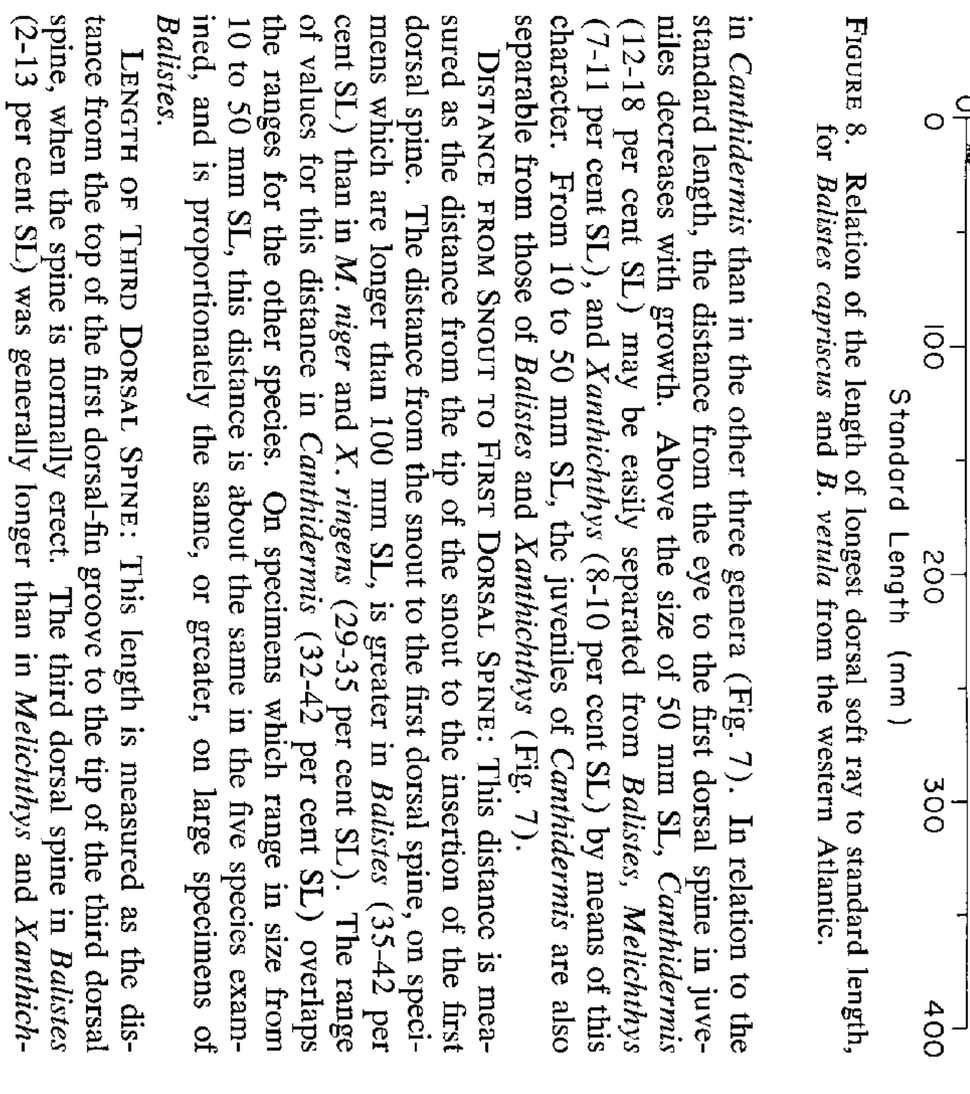

FIGURE 8. Relation of the length of longest dorsal soft ray to standard length, for *Balistes capriscus* and *B. vetula* from the western Atlantic.

in *Canthidermis* than in the other three genera (Fig. 7). In relation to the standard length, the distance from the eye to the first dorsal spine in juveniles decreases with growth. Above the size of 50 mm SL, *Canthidermis* (12-18 per cent SL) may be easily separated from *Balistes*, *Melichthys* (7-11 per cent SL), and *Xanthichthys* (8-10 per cent SL) by means of this character. From 10 to 50 mm SL, the juveniles of *Canthidermis* are also separable from those of *Balistes* and *Xanthichthys* (Fig. 7).

DISTANCE FROM SNOUT TO FIRST DORSAL SPINE: This distance is measured as the distance from the tip of the snout to the insertion of the first dorsal spine. The distance from the snout to the first dorsal spine, on specimens which are longer than 100 mm SL, is greater in *Balistes* (35-42 per cent SL) than in *M. niger* and *X. ringens* (29-35 per cent SL). The range of values for this distance in *Canthidermis* (32-42 per cent SL) overlaps the ranges for the other species. On specimens which range in size from 10 to 50 mm SL, this distance is about the same in the five species examined, and is proportionately the same, or greater, on large specimens of *Balistes*.

LENGTH OF THIRD DORSAL SPINE: This length is measured as the distance from the top of the first dorsal-fin groove to the tip of the third dorsal spine, when the spine is normally erect. The third dorsal spine in *Balistes* (2-13 per cent SL) was generally longer than in *Melichthys* and *Xanthich-*

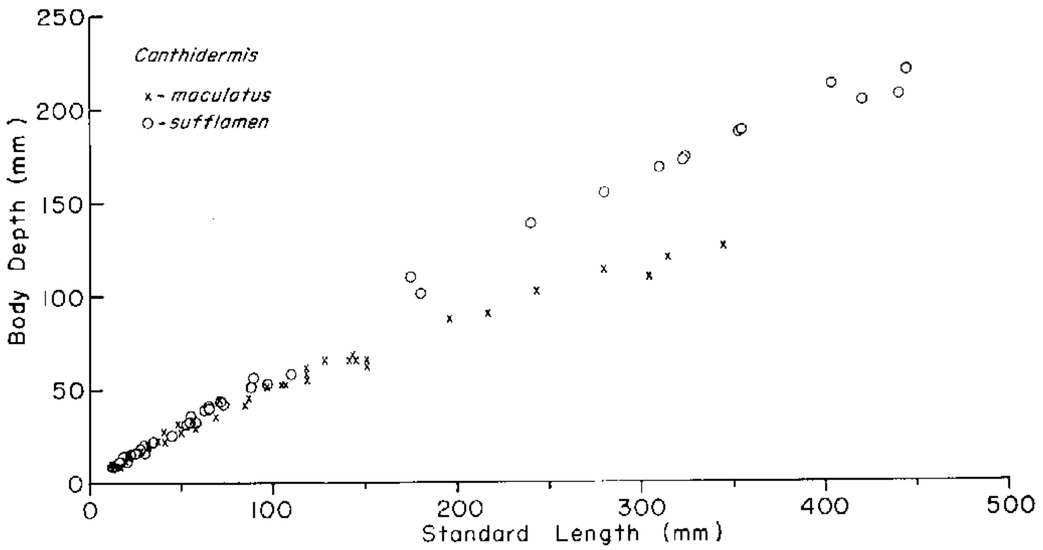

FIGURE 9. Relation of body depth to standard length for *Canthidermis maculatus* and *C. sufflamen* from the western Atlantic.

thys (0-2 per cent SL) in all sizes examined. The length of the third dorsal spine in the two species of *Canthidermis* (0-8 per cent SL) varied too greatly to be diagnostic.

LENGTH OF THE LONGEST DORSAL SOFT RAY: This length is the distance from the insertion to the tip of the longest dorsal soft ray, measured along the side of the ray. On specimens which are larger than 150 mm SL, as shown in Figure 8, the longest dorsal rays in *B. vetula* (36-71 per cent SL) are usually longer than those in *B. capriscus* (23-29 per cent SL). This is true also for *B. vetula* in comparison with *Canthidermis* (22-36 per cent SL), and *M. niger* (16-22 per cent SL). *M. niger* is separable from the longer-rayed *B. capriscus*. On specimens smaller than 100 mm SL, the longest dorsal rays of all six species are generally short. They are about equal to, or slightly shorter than, those on large specimens of *C. maculatus*, *B. capriscus*, and *M. niger*.

LENGTH OF LONGEST ANAL SOFT RAY: This length is the distance from the insertion to the tip of the longest anal soft ray, measured along the side of the ray. The longest anal soft ray in *C. sufflamen*, *C. maculatus*, *B. vetula*, and *B. capriscus* (20-35 per cent SL) is longer than in *X. ringens* (16-19 per cent SL) on specimens larger than 100 mm SL, and longer than in *M. niger* on specimens over 200 mm SL (16-19 per cent SL).

BODY DEPTH: The body depth is the vertical distance from the point of emergence of the pelvic process to the base of the first dorsal fin. In *C.*

maculatus and *X. ringens*, body depth decreases greatly in proportion to standard length in larger specimens (Figs. 4, 5), whereas in the other four species there is little or no decrease (Figs. 1, 2, 3, & 6). In specimens larger than 150 mm SL, *C. maculatus* (36-45 per cent SL) is separable from *C. sufflamen*, *Balistes*, and *Melichthys* (47-63 per cent SL) by means of this character. Figure 9 gives a comparison between *C. maculatus* and *C. sufflamen*. For small specimens in the range of 10-50 mm SL, body depth as a percentage of standard length is generally great (48-77 per cent SL) for all of the species examined (Figs. 2C, 5C, & 6C); it is usually as great as in large specimens of *Balistes* and *C. sufflamen* (Figs. 1A, 2A, & 6A). Another body depth, the distance between the origins of the second dorsal fin and anal fin, was also measured, but the differences among species, though similar to those for the depth measurement discussed above, were less distinct.

DEPTH AT CAUDAL PEDUNCLE: This measurement is defined as the least vertical depth. The depth at the peduncle is generally greatest in *Canthidermis* (Figs. 5 & 6). When specimens larger than 50 mm SL are considered, the two species of *Canthidermis* have a deeper caudal peduncle (10-15 per cent SL) than either *B. vetula* (7-9 per cent SL) or *X. ringens* (7-8 per cent SL). On specimens larger than 100 mm SL, the peduncle in the two species of *Canthidermis* is usually deeper (10-14 per cent SL) than in the other four species (7-10 per cent SL).

Fifteen other body parts were measured (fork length; total length; head length; postorbital head length; snout width; distances of snout to second dorsal fin, to anal fin, to pectoral fin, and to pelvic process; caudal peduncle length; lengths of second dorsal-fin base and anal-fin base; lengths of first and second dorsal spines; and pectoral-fin length). None proved useful for separating species. For most sizes examined, measurements for some body parts are proportionately similar in all of the species; for other body parts the range within a species is wide.

RANGES OF SPECIES

All six species occur in tropical waters; two have circumtropical distributions.

B. capriscus is known to occur in the eastern and western tropical Atlantic. Its range in the western Atlantic extends from Nova Scotia through the Gulf of Mexico to Argentina (Briggs, 1958: 298).

B. vetula has been recorded from the Indian Ocean, the western Pacific, and the eastern and western tropical Atlantic; it has a known range in the western Atlantic from Massachusetts through the Gulf of Mexico to Brazil (Briggs, 1958: 298; de Beaufort, 1962: 282).

M. niger has a circumtropical distribution and is usually associated with coral reefs. In the western Atlantic, its range is from Bermuda, Bahamas,

south Florida, and Texas[3] to Brazil (Briggs, 1958: 299; de Beaufort, 1962: 284).

X. ringens is known only from the western Atlantic, from Bermuda and South Carolina through the northern Gulf of Mexico and to the Lesser Antilles (Briggs, 1958: 299; excluding reference to Indian Ocean).

C. maculatus is circumtropical; its range in the western Atlantic is from New Jersey through the northeastern and southeastern Gulf of Mexico to Argentina.[4]

C. sufflamen has been recorded only in the western Atlantic, from Massachusetts to Bermuda, through the Gulf of Mexico, to the Lesser Antilles (Briggs, 1958: 298).

Specimens Examined

The specimens are listed below by species and arranged by location of capture, generally from north to south. Specimens listed without a designation of museum or collection are in the collections of the U. S. Bureau of Commercial Fisheries Tropical Atlantic Biological Laboratory, Miami, Florida (TABL).

The following abbreviations are used:

ANSP	Academy of Natural Sciences of Philadelphia
BLBG	U. S. Bureau of Commercial Fisheries Biological Laboratory, Brunswick, Georgia
BLGT	U. S. Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas
BU	Boston University
ChM	Charleston Museum, South Carolina
CNHM	Chicago Natural History Museum
MCZ	Museum of Comparative Zoology, Harvard
SIO	Scripps Institution of Oceanography
SU	Stanford University
TU	Tulane University
UCLA	University of California at Los Angeles
UF	University of Florida
UMML	University of Miami Marine Laboratory
UMMZ	University of Michigan Museum of Zoology
USNM	U. S. National Museum
Cr.	cruise
Reg.	regular station
Spc.	special station
Std.	standard station
Sta.	station
Supl.	supplementary station

[3] The known range is extended to Texas since several live specimens, which I later examined, were captured on a reef off Galveston (28°10′N., 94°18′W.) in October, 1965, by personnel of Sea Arama of Texas, Galveston.

[4] The known range is extended north to New Jersey and south to Argentina by respectively listing the following specimens of *C. maculatus*: Boston University, uncatalogued, collected on a cruise of the Delaware at 39°44′N., 77°00′ W., 59.4 mm SL; and Museum of Comparative Zoology, Harvard, MCZ 11887, collected at Buenos Aires, 151 mm SL.

Balistes capriscus.—Newport, R. I., (1 specimen) 66.8 mm SL, ANSP 804. Silver Bay Sta. 1271, (1) 73.5. Gill Cr. 3, Reg. 64, (1) 55. Gill Cr. 3, Reg. 63, (2) 70-72. Silver Bay Sta. 3348, (2) 218-319. Gill Cr. 8, Reg. 55, (1) 60. Silver Bay Sta. 3330, (1) 231. Silver Bay Sta. 2525, (1) 116. Gill Cr. 3, Reg. 61, (2) 19-50. Silver Bay Sta. 3324, (4) 215-309. Gill Cr. 3, Reg. 62, (3) 15-64.5. Gill Cr. 4, Reg. 32, (1) 18.5. 16 miles south of Horn Island Pass, Mississippi, 26-27 Jan. 1959, (2) 103-127. Silver Bay Sta. 4344, (4) 20.5-81.4. Silver Bay Sta. 3757, (1) 255. Gill Cr. 8, Reg. 18, (1) 27. Combat Sta. 474, (14) 24-75. Silver Bay Sta. 923, (1) 115. Gus Cr. 2, Sta. E 26, (1) 118.5, BLGT. Gill Cr. 4, Reg. 15, (1) 23. Gill Cr. 4, Reg. 16, (1) 30. Oregon Sta. 1372, (2) 14.8-15.6. Oregon Sta. 1356, (4) 22.6-53.2. Gus Cr. MWT 1, Sta. 1-3, 19 Sept. 1963, (1) 207, BLGT. Belle of Texas Cr. 28, Sta. E 11, (1) 80.4, BLGT. Miss Angela Cr. 16, Sta. E 2, (3) 94.5-108.5, BLGT. Belle of Texas Cr. 28, Sta. E 2, (1) 157, BLGT. Gus Cr. 2, Sta. E 2, (1) 94.5, BLGT. Belle of Texas Cr. 30, Sta. E 2, (1) 91, BLGT. Gus Cr. 2, Sta. E 23, (1) 74.1, BLGT. Belle of Texas Cr. 28, Sta. E 15, (1) 81.3, BLGT. Gus Cr. 1, Sta. E 50, (1) 90.5, BLGT. Oregon Sta. 1134, (2) 13.1-16.9, CNHM 64243. Gus Cr. 10, Sta. W 24, (1) 176, BLGT. Belle of Texas Cr. 29, Sta. W 20, (1) 88.9, BLGT. Combat Sta. 459, (11) 17.5-67, BLBG. Gus Cr. 3, Sta. W 62, (1) 155, BLGT. Combat Sta. 458, (1) 20.6. Dade County, Florida, 1964, (1) 142.5, BLGT. Bear Cut in front of Marine Laboratory, Virginia Key, Dade County, Florida, (1) 27.2, UMML Supl. 220. 10 miles east of Sea Buoy, Miami, Florida, (2) 21.7-34.1, UMML Supl. 158. Jupiter Inlet, Palm Beach County, Florida, (1) 35, UF, BLBG. 10 miles east of Fowey Rocks Light, Florida, (1) 14.7, UMML NG31. 10 miles east of Fowey Rocks Light, Florida, (1) 21.3, UMML NG30D. Hawk Channel, Florida, (1) 146.5, UMML 6985. Off Matecumbe, Florida, (1) 13.8, UMML. 70 miles NW of Key West, Florida, (1) 107.5, UMML 1811. Dry Tortugas, Florida, (2) 88.8-189, UMML 1618. Combat Sta. 436, (1) 54. St. Martin Island, West Indies, (1) 44, ANSP 781. West Indies, (1) 23, MCZ 11875. Old Providence Island, western Caribbean, (2) 22.8-24, ANSP 72750.

Balistes vetula.—Twenty miles south of Aransas Pass, Texas, (1) 387, BLGT. South Lake Worth, Palm Beach, Florida, (1) 45, UF 4077. Crandon Park Marina, Key Biscayne, Florida, (1) 16.4, UMML Supl. 221. Bimini, Bahamas, (1) 196.5, UMML 7943. Silver Bay Sta. 3479, (2) 176-261, BLBG. Nassau, Bahamas, (1) 158.5, USNM 53241. Silver Bay Sta. 3493, (1) 292. Pigeon Cays, 11 miles SE of Andros Island, Bahamas, (1) 271.5, UMML 1789. Bahamas, (3) 188-202, USNM 6103. Puerto Rico, (1) 178.5, USNM 126421, Fish Hawk. Jamaica, (1) 140, USNM 160723. Ambergris Cay, Yucatán, Mexico, (1) 93, USNM 79248.

Calvary Bay, St. John, Virgin Islands, (1) 133, UMML 6660, V.I. Sta. 12. OREGON Sta. 3563, (2) 225-274. Marigot Lagoon, St. Lucia, BWI, (2) 40.6-44.4, USNM 170139. Between Main Island and Pigeon Island, St. Lucia, BWI, (1) 49.5, USNM 170212. Kingston, St. Vincent Island, BWI, (1) 53.5, ANSP 39846. Old Providence Island, western Caribbean, (5) 33.2-36.1, ANSP 72750. Tobago Cays, Grenadines, (2) 39-55.5, USNM 170174. No data, (1) 250, UMML.

Balistes polylepis.—PACIFIC: Magdalena Bay, north end of Sta. Margarita Island, Baja California, Mexico, (1) 288, SIO 60-355-34A. Off Isla Nayarit, Isabella, Mexico, (1) 295, SIO 62-65-34A. Panamá—purchased, (2) 76.8-80.0, ANSP 45131-32.

Balistes punctatus.—Porto Grande, St. Vincent, Cape Verde Islands, (1) 342, USNM 42173. Off mouth of St. Paul River, Liberia, (1) 193, USNM 197498. Mensurado River Beach, Liberia, (1) 202, USNM 197497. Market at Lagos, Nigeria, (1) 63.3, ANSP 101327. Mbode, Cameroon, Africa, (2) 133-134, SU 15949.

Melichthys niger.—Outer reefs, Bermuda, (1) 163, USNM 175778. Dade County, Florida, (1) 240, BLGT. Bimini, Bahamas, (1) 223, UMML 7944. Hogsty Reef, NW Cay, Bahamas, (1) 282, ANSP Chaplin Bahamas Collection, Sta. 578. Hogsty Reef, NW Cay, Bahamas, (1) 246, ANSP Chaplin Bahamas Collection, Sta. 581. Hogsty Reef, NW Cay, Bahamas, (3) 251-292, ANSP Chaplin Bahamas Collection, Sta. 585. Rum Cay, Bahamas, (1) 270, USNM 38372. Cuba, (1) 262, USNM 25238. Tropical Research Medical Laboratory, San Juan, Puerto Rico, (2) 222-230, UMMZ 172720. Tropical Research Medical Laboratory, San Juan, Puerto Rico, (1) 211, UMMZ 172734. La Parguera, Puerto Rico, (1) 96, UMMZ 673096. Congrejos, Puerto Rico, (1) 150, UMML 2168. St. Andrews Cay, Caribbean Sea, (1) 249, ANSP 89029. OREGON Sta. 4987, (1) 93.5. Pelican Island, Barbados, BWI, (1) 115, SU 37293. Ascension Island, (1) 254, USNM 42308. Ascension Island, (3) 179-188, BU, uncatalogued CRAWFORD Cr. 10.

PACIFIC: Revillagigedos Islands, Clarion Islands, (1) 305, UCLA W53-52. Clipperton Island, (8) 126-265, UCLA W56236. Isla de Cocos, Costa Rica, (1) 113, UCLA W53-126. Isla de Cocos, Costa Rica, (2) 205-207, SIO 59-334-34A.

Xanthichthys ringens.—Bermuda, (1) 74, USNM 178037. GILL Cr. 3, Spc. 5, (1) 47.7. SILVER BAY Sta. 4369, (1) 39.6. OREGON Sta. 1356, (1) 31.7. OREGON Sta. 1380, (2) 18.1-39.5, UMML 2975. SILVER BAY Sta. 4371, (2) 23.8-43.4. SILVER BAY Sta. 4373, (1) 47. GILL Cr. 3, Std., 26°23′N, 76°46′W, (2) 40.7-46.1. GILL Cr. 7, Std., 26°20′N, 76°47′W, (2) 36.4-49.1. GILL Cr. 7, Std., 26°20′N, 76°44′W, (2) 37.4-49.6, BLBG. GILL Cr. 3, Std., 26°20′N, 76°43′W, (1) 65.3. GILL Cr. 3, Std., 26°19′N, 76°45′W, (1) 38. Grand Bahama Island, (1) 90, ANSP Sta. 61-F. Havana, Cuba, (1) 150, USNM 24792. Havana, Cuba, (2) 151-163.5, ANSP 87891. Cozumel Island, Yucatán, Mexico, (1) 160.5, UMML 9414. OREGON Sta. 1294, (2) 28.0-50.6. Four miles SE of Rams Head, St. Johns, Virgin Islands, (2) 97.5-100.5, UMML 6249, V.I. Sta. 112. Port Castries, St. Lucia, BWI, (1) 119, ANSP 74895. Courtown Cay, western Caribbean, (1) 28.4, ANSP 72782. No data, (1) 161, USNM 9481.

Xanthichthys mento.—PACIFIC: Near Melponone Cove, Guadalupe Island, Baja California, Mexico, (1) 229, SIO H53-173. San Benedicto, Bahía, Revillagigedos Islands, Mexico, (2) 216-224, UCLA, W-55-150. Socorro Island, Revillagigedos Islands, Mexico, (4) 210-227, UCLA W51-92. Anchorage in Bahia, Socorro Island, Revillagigedos Islands, Mexico, (3) 200-209, UCLA W-55-123. Bahía, Clarion Island, Revillagigedos Islands, Mexico, (1) 212, SIO 57-138-34B.

Canthidermis maculatus.—39°44′N, 70°00′W, (1) 59.4, BU, DELAWARE. 36°57′N, 68°05′W, (1) 36.8, BU, uncatalogued, DELAWARE. Flatts Inlet, Bermuda, (2) 14-17.7, CNHM 48623. Argus Bank, Bermuda, (1) 86.9, CNHM 48578. Argus Bank, Bermuda, (1) 143, UMMZ 176500. Seabrooks Beach, South Carolina, (1) 244, ChM 34.360. Gulf Stream, (1) 129, MCZ 11901. 31°03′N, 45°58′W, (1) 196, MCZ 39769. COMBAT Sta. 474, (1) 69.4. SILVER BAY Sta. 4369, (1) 72. Gulf of Mexico, halfway between shore and Continental slope, (1) 345, USNM 158569. OREGON Sta. 1590, (1) 109, UF 3194. OREGON Sta. 820, (2) 130-151, TU 6732. OREGON Sta. 1616, (1) 107, ANSP Tyler Collection. Florida Current, (1) 41, UMML 4433, Supl. 27. Crandon Park Marina, Key Biscayne, Florida, (1) 15.8, UMML, 8 Feb., 1961. Miami, Florida, Pier 5, (1) 105.5, UMML 431. Off Miami, Florida, (1) 280, UMML 10933. Terminal Yacht Basin, Miami Beach Causeway, Dade County, Florida, (1) 49.0, UMML 2556. Biscayne Bay at Pier 5, Dade County, Florida, (1) 304.5, UMML 9317. Miami, Coconut Grove, Biscayne Bay, Dade County, Florida, (3) 13.5-21.7, UMML 3976. Bimini, Bahamas, (1) 142, ANSP 67717. COMBAT Sta. 457, (2) 57.8-85.0, BLBG. OREGON Sta. 2196, (1) 315. OREGON Sta. 1068, (1) 217, ANSP Tyler Collection. OREGON Sta. 1234, (1) 40.3, CNHM 61360. 19°40′N, 74°30′W, (1) 145, BU, ATLANTIS. ATLANTIS Sta. 5581, 19°12′N, 62°05′W, (1) 37.1, BU. West Indies, (1) 119, MCZ 11875. Buenos Aires, (1) 151, MCZ 11887. No data, (1) 119, MCZ 39766.

PACIFIC: Salina Cruz, Bahía, Chipequa, Mexico, (1) 212, SIO 58-375. 150 miles SW of Acapulco, Mexico, (1) 154, SIO 62-168-34B. 100 miles in Pacific, between Guatemala and El Salvador, (1) 228, SIO 57-75. 0-1 mile NW of wreck on NE shore of Clipperton Island, (3) 415-475, UCLA

W56236. 14°01′N, 116°13′W, (1) 210, SIO 58-370. 10°00′N, 111°08′W, (1) 236, SIO 55-227. 08°00′N, 115°37′W, (2) 211-227, SIO 58-368. 05°00′N, 78°09′W, (1) 235, SIO 55-245. 04°53′N, 81°30′W, (3) 51.9-78.5, ANSP 86765. 04°03′N, 78°47′W, (1) 211, SIO 55-243.

Canthidermis sufflamen.—38°08′N, 70°58′W, (1) 74.9, CNHM, BEAR. 38°05′N, 65°58′W, (1) 180, BU, DELAWARE. 36°42′N, 70°00′W, (1) 38.7, BU, DELAWARE, 3 Oct., 1957. SILVER BAY Sta. 2172, (1) 23.3. GILL Cr. 8, Reg. 80, (1) 34.8. SILVER BAY Sta. 2201, (1) 24.0. GILL Cr. 7, Reg. 73, (1) 50.3. Flatts Inlet, Bermuda, (3) 12.6-15.0, CNHM 48623. GILL Cr. 7, Reg. 72, (1) 30.0. GILL Cr. 2, Reg. 59, (1) 12.6. GILL Cr. 2, Reg. 40, (1) 15.5. GILL Cr. 3, Reg. 26, (1) 88.5. GILL Cr. 8, Reg. 18, (2) 11.8-19.8, BLBG. COMBAT Sta. 474, (2) 35.3-58.1. SILVER BAY Sta. 471, (1) 30.2. GILL Cr. 7, Reg. 17, (1) 27.2. COMBAT Sta. 315, (2) 21.6-23.0. OREGON Sta. 638, (1) 92, TU 12748. SILVER BAY Sta. 4369, (1) 55.7. GILL Cr. 3, Spc. 6, (1) 89. OREGON Sta. 1585, (1) 97.5, UF 1273. GILL Cr. 3, Reg. 8, (2) 13.3-18.7. OREGON Sta. 593, (1) 55.9, CNHM 59850. SILVER BAY Sta. 4231, (1) 240. SILVER BAY Sta. 4373, (1) 65.1. SILVER BAY Sta. 4372, (1) 71.7, BLBG. Bear Cut in front of Marine Laboratory, Virginia Key, Biscayne Bay, Florida, (2) 21.7-22.8, UMML Supl. 220. Crandon Park Marina, Key Biscayne, Florida, (1) 12.0, UMML. Crandon Park Marina, Key Biscayne, Florida, (1) 12.6, UMML Supl. 221. Bear Cut, Dade County, Florida, (1) 280, UMML 5183. Off Florida, (1) 175, Marine Studios, Marineland, Florida. Bahamas, (1) 445, ANSP Chaplin Bahamas Collection Sta. 517. Off Lerner Dock, Bimini, Bahamas, (1) 324, UMML 1787. Hogsty Reef, West end of Northwest Key, Bahamas, (1) 353, ANSP Chaplin Bahamas Collection Sta. 585. Yacht Basin, Pier 5, Miami, Florida, (1) 26.2, UMML 785. Bimini and/or Cat Key, Bahamas, (4) 12.4-17.4, UMML 1464. One mile off Brackens Hotel, Palm Beach, Florida, (1) 376, CNHM 46789. Jupiter Inlet, Palm Beach County, Florida, Aug., 1958, (1) 56, UF. COMBAT Sta. 459, (1) 33.6. OREGON Sta. 1035, (1) 49, TU 10935. OREGON Sta. 1298, (1) 96.5, BLGT. GILL Cr. 3, Std. 26°23′N, 76°50′W, (1) 109.5. GILL Cr. 7, Std. 26°20′N, 76°44′W, (1) 54.1. GILL Cr. 7, 26°06′N, 78°08′W, (1) 32.2. OREGON Sta., 25°N, 89°W, Gulf of Mexico, (1) 44.9, CNHM 46693. COMBAT Sta. 436, (1) 53.1. Yucatán, Mexico, (2) 421-441, USNM 157714. Off La Parguera, Puerto Rico (1) 63, UMML 5888. La Parguera, Puerto Rico, (1) 310, UMML 2422. St. Johns, Virgin Islands, (1) 404, UMML 5147, V.I. Sta. 24. St. Martin Island, West Indies, (1) 65.2, ANSP 800. St. Martin Island, West Indies, (1) 277, ANSP 806 (Skin). OREGON Sta. 3563, (1) 355. Santa Cruz, Curaçao, (1) 323, BLGT.

SUMARIO

PECES DE LA FAMILIA BALISTIDAE DEL ATLANTICO OCCIDENTAL

Seis especies de la familia Balistidae viven en el Atlántico Occidental: *Balistes capriscus, B. vetula, Melichthys niger, Xanthichthys ringens, Canthidermis maculatus* y *C. sufflamen.*

Se sitúa a *Melichthys piceus* en la sinonimia de *M. niger* y a *Canthidermis sobaco* en la sinonimia de *C. sufflamen.*

La pigmentación y coloración de las seis especies varía en los distintos ejemplares y en los mismos hay cambios marcados durante su desarrollo.

Tres especies: *Balistes capriscus, B. vetula* y *Melichthys niger* tienen escamas o placas de mayor tamaño inmediatamente posterior a la abertura de las branquias y también una articulación flexible conectando la parte externa expuesta del proceso pelviano con la parte proximal del proceso que descansa bajo la piel. Las otras tres especies carecen de estos caracteres. Las tres primeras especies difieren en el número de radios anales (*B. capriscus*, 23-26 radios anales; *B. vetula*, 27-28; *M. niger*, 29-31). Las otras tres especies también difieren entre sí en el número de radios de algunas de sus aletas. *C. maculatus* tiene menos radios anales (menos de 23) que *C. sufflamen* y *X. ringens*; y *C. sufflamen* tiene más radios pectorales (más de 14) que *X. ringens.*

Los cachetes de *X. ringens* tienen escamas alargadas verticalmente, separadas por tres surcos laterales. Los lados de *M. niger* tienen de 8 a 11 hileras horizontales de escamas con crestas que tienen espinas dirigidas anteriormente.

La distancia del ojo a la primera espina dorsal es mayor en *Canthidermis* (mayor que el 11 por ciento de la longitud media en ejemplares mayores de 50 mm de longitud media) que en los otros tres géneros. En ejemplares de más de 150 mm de longitud media los radios dorsales más largos son más largos en *B. vetula* (más del 29 por ciento de la longitud media) que en *B. capriscus* y el cuerpo de *C. sufflamen* es más alto (mayor del 45 por ciento de la longitud media) que el de *C. maculatus.*

Las seis especies viven en aguas tropicales; dos, *M. niger* y *C. maculatus,* tienen distribución circuntropical. Se extiende la distribución de dos especies en el Atlántico Occidental: *M. niger* hasta Texas y *C. maculatus* hasta New Jersey y la Argentina.

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